FIELD EXPERIMENTS IN SEAL COATS

MAY 1963

STATE OF IDAHO
DEPARTMENT OF HIGHWAYS

STATE OF IDAHO

DEPARTMENT OF HIGHWAYS

A REPORT

OF

FIELD EXPERIMENTS IN SEAL COATS

By

L. F. Erickson
Research Engineer

And

Harry L. Day
Materials Engineer

May 1963

TABLE OF CONTENTS

A REPORT OF FIELD EXPERIMENTS IN SEAL COATS

Background Information

Seal coating has been a rule of thumb operation or an art for many years. Only during the last decade has any scientific method of designing and applying asphaltic materials and cover coat aggregates for a seal coat become available to engineers. The first known published report was in the Highway Research Board Proceedings for 1953 entitled, "Tests and Theories on Penetration Surfaces", by Jerome P. Kearby, then the Senior Resident Engineer for the Texas Highway Department. This report was discussed and information therefrom was presented at the Asphalt Institute meeting in November, 1956 by the Materials Engineer of the Department of Highways. Papers written in the meantime by Mr. Lovering of the California Highway Department and now with the Asphalt Institute, and others were also covered in this same discussion.

During 1958, District 6 of the Highway Department began to use this method in the application of seal coats by State Forces throughout their District. This work in District 6 was covered by a special report with the title, "A Report on Covercoat and Surface Treatments for the

State of Idaho, Department of Highways," and was prepared for Blaine Sessions by Dean Van Noy, District Materials Technician in September, 1958. This report gave the results of work for about a dozen projects in the District 6 area, giving the calculations for the quantities of asphaltic materials and of cover coat aggregate together with a pictorial record of the results of their work. The seal projects during this year were outstanding. The results were far better than had ever been experienced before. During the winter of 1958-1959, the laboratory prepared and submitted this report to all Districts - including pictures and other information that were pertinent to the work of District 6. The laboratory at this time prepared and submitted " a standard method for the design of seal coats and single surface treatments". . . Idaho Designation T60-59.

At this time other asphaltic products were coming into use - notably rubberized asphalt and also asphaltic materials with various anti-stripping agents were available. During August of 1958, District 4 placed a seal coat north from Moscow on U.S. 95 using a rubberized RC-3 or RC-3DN as it was designated. An RC-5 asphalt was also used in this experiment of District 4. A Class 2 basalt cover coat material and a granite Class 2 cover coat were used on this project.

In 1959, District 6 again experimented by using an anionic emulsion RS-2, a cationic emulsion RS-2T, a rubberized asphalt RC-3DN, and RS-2 with an anti-stripping agent. This experiment was conducted on Highway 28 from Terreton north to the vicinity of Leadore.

In 1959, District 3 conducted an experiment on U.S. Highway 30 between the Union Pacific Railroad Depot and the mouth of Isaac's Canyon southeast of Boise. They used 120-150 penetration asphaltic

cement, a RC-5 and a RC-4N rubberized asphalt. A total of 24 sections alternating between these three grades of asphalt were placed, using a Class 3 cover coat material from a gravel pit (A-57) in the vicinity of Gowen Field. The seal coat work conducted in District 6 and District 3 was designed using the Kearby Method of determining the quantities of asphalt and cover coat material.

District 6 Experimental Seal Coating Projects - Highway 28

The District 6 experiment was conducted in early September, 1959. Its purpose was to compare the performance of rubberized RC-3DN materials with cationic emulsions and with anionic emulsion. The experiment was conducted between mileposts 214 and 217 on Highway 28. Asphaltic materials used were an RS-2 emulsion, an RS-2T cationic emulsion, and RC-3DN rubberized asphalt. Weather conditions at the time of application were windy and cloudy with air temperatures varying from 65 to 75 degrees. The pavement temperature was from 75 to 80 degrees. The cover coat material, Class 3, applied at a rate of 19 pounds per square yard from source C1-18 consists of limestone, basalt and sandstone aggregates. The asphaltic material was applied so that there would be a bitumen content of 0.22 of a gallon per square yard making allowance for the water within the emulsions. Actual application rates of 0.25 gal. per square yard for the RC-3DN, 0.29 gal. per square yard for the RS-2T and 0.32 gal. per square yard of the RS-2 were used. The cover coat material, Class 3, had two percent passing the No. 10 sieve and one percent passing the No. 200 sieve.

The entire test section was rolled with steel wheel power rollers as pneumatic rollers were not available. An effort was made to roll the test section with the wheels of gravel trucks in lieu of the pneumatic tire rollers.

The District reported October 19, 1959, that the section using RC-3DN was satisfactory, but that the sections using RS-2 and RS-2T had poor retention. The cationic emulsion RS-2T appeared to have slightly better retention in the southbound lanes than when used in the center of the roadway. There was no apparent difference in the sections where RS-2 emulsion was used. Near freezing weather which occurred during the day after application and freezing weather during the nights for about two weeks thereafter could materially have affected the performance of the sections wherein emulsions were used.

An inspection of these sections on June 19, 1962 indicated that the section where in the RC-3DN was used appeared satisfactory with perhaps 90% retention of cover coat. The sections using emulsion had less than 10 percent retention and must be classified as a failure.

District 4 Experimental Test Section

District 4 placed an experimental test section during August 1958 on Highway U.S. 95 north of Moscow. Materials used in this experiment included RC-3DN, a rubberized asphalt, and an RC-5 liquid asphalt. Class 2 and 3 cover coat materials were used from two sources, one a basalt aggregate and the other a granite aggregate.

Application rates were about the same, 0.27 gallons per square yard and cover coat materials were applied at a rate of 25 pounds per square yard. Weather was reported to be nearly ideal for seal coating operations.

The District reported October 19, 1959 that the RC-3DN sections were much better than the RC-5 sections although the RC-3DN appeared to have a rougher surface. An examination of these sections during July and August, 1962 indicated satisfactory performance with excellent chip

retention for all sections. There was some slight to moderate bleeding in the wheel paths on some sections although not serious. Indications were that no great advantage could be obtained by the use of the rubberized asphalt, RC-3DN.

District 3 Experimental Seal Coat on US 30 Depot - East

The experiment in District 3 was conducted in early September, 1959 and consisted of 24 experimental sections, 11 using RC-4N a rubberized asphalt, 8 sections with 120-150 penetration asphalt, and 5 sections with RC-5. The same Class 3 cover coat material was used on all of these sections and had only 2% passing the No. 10 sieve with 100% passing the one-half inch sieve. The minimum temperatures over any twenty-four hour period for the seven days following application did not drop below 48 degrees with the average in the low or mid 50's. Air temperatures during the application period on September 2 ranged from 67 to 85 degrees with a mild wind of 9 miles per hour blowing and from 68 to 85 degrees on September 3, with 11 miles per hour estimated wind velocity although remarks made were that it was definitely windy. Application temperatures of the asphaltic materials were 250 to 260 degrees for the RC-5, 240 to 250 degrees for the RC-4 modified with neoprene rubber, and 330 to 340 degrees for the 120-150 penetration asphalt. The Kearby formula was used and with 30 percent embedment figured to give 0.23 gallons per square yard of asphaltic materials. Various sections were staggered on opposite sides of the road using the three grades of asphalt with application rates varying from 0.180 to a maximum of about 0.223 gallons per square yard. Retention of chips after completion of the work was good on all sections. Construction involved the use of pneumatic tired rollers as well as steel wheeled rollers.

During the spring of 1960, an examination was made of the condition of the experimental sections. This examination, June 7, 1960 showed that for the 120-150 penetration grade asphalt, all sections had at least 50% retention of chips and the RC-5 also had about 50% retention. The RC-4N was rated at 90% retention. Another examination, November 1, 1960 indicated that for the RC-5 and 120-150 additional chips had been lost such that they were rated from 25 to 50% retention. The RC-4N, however, still rated very good with about 90% retention. An examination of these sections in late 1962 for purposes of rating the retention of chips indicated that the RC-5 and 120-150 must be classed as very poor to poor. The RC-4N would be classed as fair to very good. Actual ratings for the RC-4N were from 30 to 90% retention with probably an average of about 50%. The 120-150 rated from 10 to 35% and the RC-5 rated from 10 to 20% retention. Considerable difficulty in rating these sections was experienced due to two previous seal coats applied to this roadway. Even though the chips for the last seal appeared to have been removed, the cover coat material was visible from the previous seal coat and gave extreme difficulty in determining whether the visible aggregate was from a previous seal or the existing seal. For this reason, it was necessary to review the previous condition surveys and to consider the ratings for the 1960 surveys in making the evaluation during the 1962 survey.

General Observations

Our observations of these experimental sections in District 6 and District 4 and District 3 indicate that of 54 experimental sections, 23 would be rated as satisfactory with 75% or more chip retention. Nine would be rated as fair with from 50 to 75% retention, and 22 must be classed as unsatisfactory with less than 50% retention of cover coat material.

Not all desirable data is available for all of these experimental projects. Application rates are available in some instances, but ground temperatures are often missing and weather records are incomplete and particularly precipitation following the application of these seal coat projects.

A study of these experimental projects indicates that as experiments they can be rated from fair to good. No special field procedures were involved. The work was done by State Forces in their normal course of operations and was accomplished by merely making a slightly more complete record of applications and temperatures. Not all essential records are available that would be desired for a research project. Only one project was involved in a number of repeat sections of the application rates. Future experimental seal coats should be carefully set up prior to the actual commencement of work and the experiment should, if possible, be conducted during the months of July and August unless late season work is to be studied. Complete records should be made of pavement temperatures, air temperatures, sun and wind, quantities of materials applied and of all construction procedures used, that is, types of rollers, time elapsed between application of asphalt, application of the chips and the number of coverages of rolling, traffic control and other factors that may influence the performance of the project. Precipitation and particularly snow or other adverse weather can materially influence the performance of a seal coat project, and should be made a matter of record for at least two weeks or preferably a month following application of the seal coat where cutback type asphalts or emulsions are used.

Conclusions

These projects indicate the following:

(1) The use of insufficient asphalt in many instances has adversely effected the performance of these test sections, and had a greater embedment been used, performance may have been entirely different.

(2) RC-3DN and RC-4N, (a standard RC-3 and RC-4 with Neoprene rubber) gave excellent performance in retaining cover coat aggregates even though the embedment of stone in several instances was low.

(3) RC-5 on US 30 gave poorer performance than 120-150 penetration asphalt again due in part to insufficient embedment and probably no correction for loss of volatiles. RC-5 on US 95 gave very good performance with heavier applications.

(4) RS-2 and RS-2T gave poor performance on Highway 28 and can be explained partly by cold nights and freezing temperatures within two days of the construction of the seal coat and for two weeks thereafter.

(5) Weather during construction and for a period following the seal coat may adversely affect performance, particularly where emulsified asphalt is used.

(6) Experimental seal coat projects are worthwhile. However, extra effort is necessary to obtain precisely: design quantities of asphalt, intended variations in application rates, and that all factors, weather, pavement temperatures and construction procedures are made a matter of record.

APPENDIX

Construction Information - Data Relative to

Sections, Temperature, Application Rates

Sources of Materials, Performance Ratings

C
O
P
Y

X-1020
Special Maintenance
Lemhi County

DEPARTMENT OF HIGHWAYS

October 19, 1959

TO: DISTRICT ENGINEER

FROM: DISTRICT MATERIALS CHIEF

SUBJECT: Seal Coat Test Section

On September 4, 1959 a seal coat test section was constructed by State Maintenance Forces on Highway 23 between Lone Pine and Gilmore Summit. The purpose of the test section was to compare the performance of a rubberized cut-back asphalt and a cationic emulsion with asphaltic road materials currently being used by the Department for seal coat maintenance work. Since a regular RS-2 emulsified asphalt was being used in the vicinity of the test section, it was chosen as the currently used material for the comparison.

The three asphaltic materials in the test section were applied side by side. From Mile Post 214.07 to 215.55 the regular RS-2 was applied on the north-bound side; RS-2T, cationic in the center; and RC-3DN, rubberized, on the south-bound side. From Mile Post 215.55 to 217.3 RC-3DN was placed on the north-bound side, RS-2 in the center and RS-2T on the south-bound side.

Personnel present at the time of construction of the test section in addition to the regular Special Maintenance crew were B. E. Sessions, District Engineer; R. A. Shuppenies, District Maintenance Engineer; Dean Van Noy, District Materials Chief; and David Scholes, Inspector of the Department of Highways. Mr. LaBelle of Utah Emulsions, supplier of the cationic emulsions, was also present.

The weather conditions at the time the test section was constructed were windy and cloudy, with air temperature varying from 65 to 75° F.; the pavement temperature was 75 to 80° F.

Cover Coat Material, Class 3, from source Le-67 was used for the test section. The cover coat material was spread at the rate of 19 pounds per square yard for the entire section. The average gradation of the material used is shown in table I.

TABLE I

Sieve Size	% Passing	Class 3 Spec.
1/2"	100	100
3/8"	88	
#4	25	
#10	2	0-6
#200	1	0-3

The laboratory design indicated the following requirements per square yard to obtain 40% embeddedness of the aggregate:

Cover Coat Material	19 Lb.
Bitumen @ 60° F.	0.22 gal.
RS-2 @ 60° F.	0.34 gal.
RC-3 @ 60° F.	0.27 gal.

Table II shows the average rate of application of asphaltic material and the application temperatures.

TABLE II

Material	Gal./sq.yd.	Distributor	Temperature
RC-3DN	0.25	State - 9373	200°F.
RS-2T	0.29	Hatch Truck Line	145°F.
RS-2	0.32	State - 8920	145°F.

The entire test section was rolled with steel wheel power rollers; no pneumatic tired roller was available. An effort was made to cover the test section with the wheels of the gravel trucks for pneumatic rolling.

The RC-3DN portion of the test section seems quite satisfactory upon visual examination, having good chip retention. Both the RS-2 and the RS-2T sections have very poor chip retention. The cationic emulsion appears to have slightly more chips retained in the south-bound lane between Mile Post 215.55 and 217.3 than in the section where the cationic was placed in the center lane between Mile Post 214.07 and 215.55. The results obtained with the RS-2 emulsified asphalt in the test section were very much the same as the results using RS-2 from the same source and cover coat material from the same stockpile applied to the areas adjacent to the test section.

The test section, as well as other seal coat work done by Special Maintenance in 1959, is still under study by the District Materials Section. A supplementary report including conclusions and recommendations will be submitted at a later date.

/s/ Dean Van Noy
Dean Van Noy
District Materials Chief

DVN/BMcM/11d

DISTRICT 6

EXPERIMENTAL SEAL COATS - HIGHWAY 28

M.P. 214.07	215.55	M.P. 217.3	M.P. 217.5
RC-3DN	RS-2T	RC-3DN	
RS-2T (Cationic)	RS-2	RS-2	
RS-2	RC-3DN	RS-2	

Weather - September 4, 1959 - Windy, Cloudy - Temperatures 65° - 75° F.

Pavement temperatures - 75° F. - 80° F.

September 5, 6, 1959 - Cold, Windy - near freezing during the day and below freezing at night.

EXPERIMENTAL SEAL COAT

S.H. 28

CONSTRUCTED SEPTEMBER 2 - 3, 1959

Mileposts	Asphalt	Gal./sy	Cover Coat Material Class	Lbs.	Source	Retention	Appearance June 1962
214-215.5	RS-2	0.32	3	19	C1-18	10	Poor
	RS-2T	0.29	3	19	C1-18	10	Poor
	RC-3DN	0.25	3	19	C1-18	90	Good
215.5-217	RC-3DN	0.25	3	19	C1-18	90	Good
	RS-2	0.32	3	19	C1-18	10	Poor
	RS-2T	0.29	3	19	C1-18	10	Poor

C O P Y

FAP 82
US 95, Maint.
Latah County

Lewiston, Idaho
October 19, 1959

MAINTENANCE ENGINEER

DISTRICT ENGINEER, DISTRICT #4

Rubberized Asphalt Seal Coat U.S. 95 (1958)

The Materials Engineer has requested that the District submit a summary of the sections of rubberized (RC 3 DN) asphalt seal coat which were applied just north of Moscow on U.S. 95 on August 25, 1958. Sections were also sealed with RC-5 in early August before permission was obtained to use rubberized asphalt.

The rates of application of RC 3 DN and RC-5 were approximately the same - 0.27 gal/S.Y. The RC-5 and RC 3 DN were applied under ideal weather conditions. Cover coat Class 3 crushed gravel was used on the sections shown on the attached print, to cover the RC 3 DN. The gravel cover coat appeared too dusty and dirty to continue its use so a switch to Class 3 basalt cover coat material was made. No apparent difference in results has been noted in the sections where the crushed gravel and crushed basalt cover coats were applied. Cover coat materials were applied at 25#/S.Y.

To date the RC 3 DN sections appear to be much better than the RC-5 sections due primarily to the chip retainage. A very distinct increased surface roughness is apparent on the rubberized sections as compared to the RC-5 sections.

The attached mile post and FAP 82 stationing map shows right and left application sections. A relatively level section near Moscow (Sec. "A") was used and a section on the south grade of Moscow Mountain (Sec. "B", 5.1 miles north of Moscow) was also used.

PHILLIP A. MARSH, P. E.
District Engineer

BY: C. B. HUMPHREY, P.E.
Assistant District Engineer

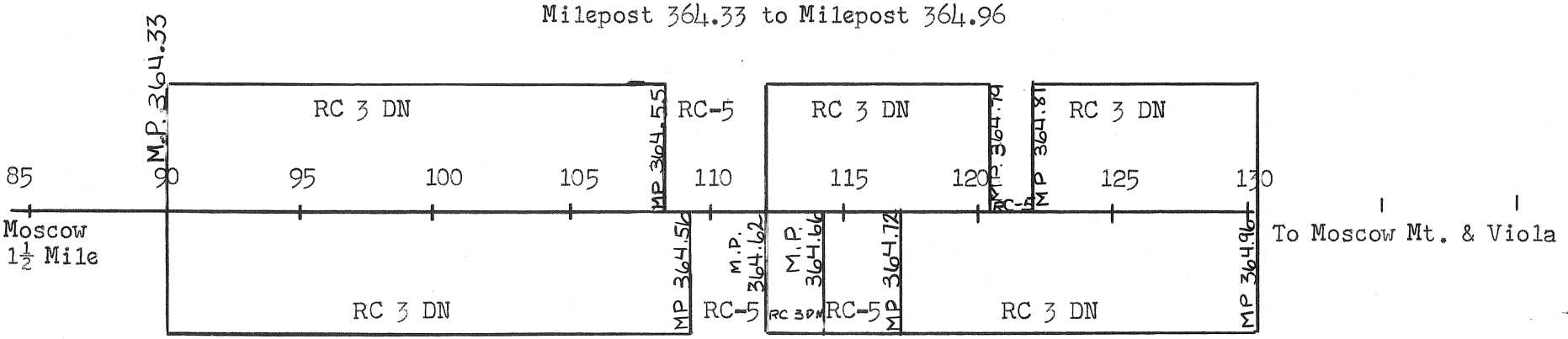
PAM/CBH:mo
Encl.
cc: Asst. St. Highway Engr. (Oper.)
Maintenance Engineer
Materials Engineer
District Materials Engineer
Asst. District Engineer

RUBBERIZED ASPHALT SEALCOATING

US 95 - North of Moscow
August 23, 1958 for RC 3 DN
July 1958 for RC-5

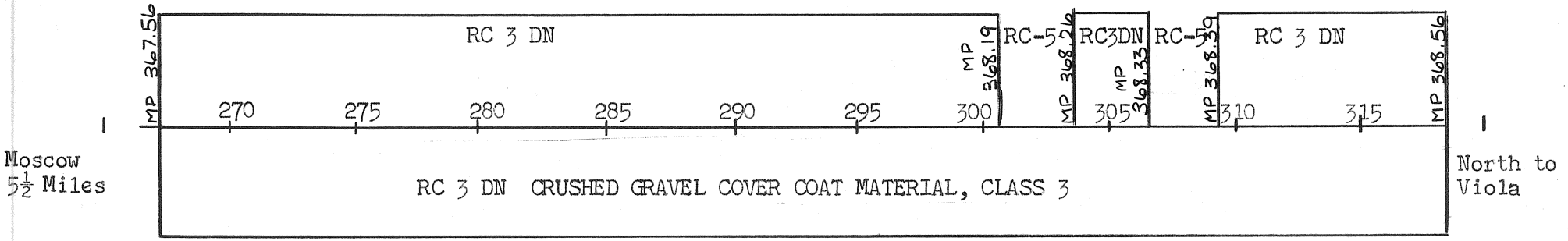
SECTION "A"

Milepost 364.33 to Milepost 364.96



SECTION "B"

Milepost 367.56 to Milepost 368.56



NOTE: All Sections Covered with Basalt Cover Coat Material Class 3 except as shown.

EXPERIMENTAL SEAL COAT
U.S. 95
MOSCOW NORTH
CONSTRUCTED AUGUST, 1958

Section	Asphalt	Chips	Aug. 1962 Retention	Aug. 1962 Appearance
Back of 84+10	RC-5	Basalt Cl. #2	Excellent	Excellent
84+10 - 87+57	RC-3DN	Basalt Cl. #2	Excellent	Excellent
87+57 Ahd	RC-5	Basalt Cl. #2	Excellent	Excellent
120+16 - 121+80	RC-5	Basalt Cl. #2	Very Good	Very Good
121+80 - 130+00	RC-3DN	Basalt Cl. #2	Very Good	Very Good
130+00 - 178+00	RC-5	Basalt Cl. #2	Very Good	Very Good
178+25 - 194	RC-3DN	Basalt Cl. #2	Very Good	Very Good
194 - 267+10	RC-5	Basalt Cl. #2	Very Good	Very Good
267+10 - 300+90	RC-3DN	Granite & Basalt	Very Good	Very Good
303+47 - 300+93	RC-5	Granite	Very Good	Very Good
303+47 - 306+58	RC-3DN	Granite	Very Good	Very Good
306+58 - 309+14	RC-5	Granite	Very Good	Bleeding on part.
309+14 - 318+27	RC-3DN	Granite	Very Good	Some bleeding in wheel paths.

C O P Y

Seal Coat Test Section
Boise East on US 20-26-30
Ada County

June 7, 1960

MAINTENANCE ENGINEER

MATERIALS ENGINEER

Condition Survey

On June 2, 1960, two representatives of the Materials Section, the Testing Engineer and Testing Technician, in accompany with the District and Assistant District Materials Chiefs, made a condition survey on captioned seal coat test section.

A close visual inspection was made of all individual sections. The following comments are based on those observations.

There wasn't enough time available to verify by test the various estimations that were made as to percentage of chip retention, asphalt quantities, etc. Listed below are the details by individual sections concerning the condition survey.

Section A1 and A2, RC-4N asphalt on both right and left lanes: The chip retention was good, uniform over the roadway, and it was estimated that there was approximately 70 percent chip retention. There was no evidence of bleeding and the asphalt appeared to be alive and was holding the chips firmly.

Section A2, on which 0.19 gallons per square yard of asphalt was used, appeared to have a slightly better chip retention than Section A1 that had 0.21 gallons of asphalt per square yard. Asphalt was visible on the surface with some chip loss at the Broadway Intersection.

Section B, RC-5 asphalt left and 120-150 Penetration asphalt right: The RC-5 section had fair chip retention; approximately 55 to 65 percent. It appeared, however, that the majority of the large chips had been lost. Due to the loss of chips there was excess asphalt on the surface and it is believed that bleeding will start with the advent of hot weather and heavy traffic.

On the right lane the penetration asphalt section had excellent chip retention, estimated to be approximately 75 percent. It also appeared that the chips were embedded approximately 30 to 35 percent, which was very close to that set up in the original design.

There was no evidence of bleeding and the seal appeared to be in very good shape. At one spot, however, in the shade of some trees there was an almost complete loss of chips which, according to the District, occurred immediately after traffic was allowed on the section last fall.

At this point is is apparent that shady areas are practically impossible to seal with a penetration asphalt.

Section C, 120-150 Penetration asphalt left and RC-5 asphalt right: On the left it appeared that the penetration asphalt had sealed areas of alligator cracked pavement quite well. Approximately 70 percent of the chips had been retained with somewhat less than that in the turning movement areas. The chips appeared to be embedded approximately 40 to 45 percent, which indicates that a lesser amount of asphalt could have been used.

On the right it appeared that the large chip loss was again higher than the 120-150 penetration section. There were approximately 60 to 65 percent of the chips remaining. It also appeared that some bleeding may occur in the wheel tracks.

Section D, RC-4N left and 120-150 Penetration right: The RC-4N section had a good seal with 70 to 75 percent of the chips remaining. There was no bleeding and it exhibited a better seal than the 120-150 penetration section on the right. This may be due to the lack of turning movements on the RC-4N section. This section had only a fair seal with about 60 percent of the chips remaining and it is possible that some bleeding will occur at the intersections and in the vicinity of the trees.

In contrast to the previous RC-5 asphalt section, however, a relatively large percentage of the large chips had been retained and there was still a rough surface.

Section E, RC-5 asphalt left and RC-4N right: The RC-5 section had a fair to good seal on the smooth roadway areas. The pavement had a good abrasive surface through this area. The section appeared to have approximately 60 to 70 percent chip retention.

On the RC-4N section the seal was fair to good on the smooth roadway areas with approximately 60 to 70 percent chip retention. On the grade the chips appeared to have rolled and possibly some bleeding will occur later on.

Through both of the above sections there were depressions in the wheel tracks. However, it was a good seal coat considering the condition of the roadway surface.

Section F, RC-4N left and 120-150 Penetration right: The RC-4N section had a very good seal with a chip retention of 80 percent plus. There was no evidence of bleeding and the roadway surface had a good, rough, abrasive surface.

The 120-150 Penetration section had a good seal and the chip retention appeared to be in excess of 75 percent. However, it was apparent that too heavy an application of asphalt was used. The chips appeared to be embedded approximately 50 to 55 percent and, as a result, only the coarse chips were visible above the asphalt.

Section G, 120-150 Penetration left and RC-5 right: The 120-150 section again had a good seal with good chip retention but too much asphalt had been applied.

The RC-5 section had a good seal with good chip retention. This particular section was on a grade but there was very little chip loss and no evidence of bleeding.

Section H, RC-5 left and RC-4N right: The RC-5 section had a good seal with 70-75 percent chip retention. This section also appeared to have too heavy an asphalt application. The chips were embedded approximately 45 to 50 percent. The heavy application may cause bleeding later on in the year.

The RC-4N section had a good seal, 70 to 80 percent chip retention, and no visible bleeding. The chips appeared to be embedded about 30 to 35 percent and the amount of asphalt seemed to be near optimum.

Section I, J and K: Through these three sections and the RC-4N and 120-150 penetration asphalt were used on alternating lanes to the end of the seal coat section. The RC-4N sections had a very good seal with chip retentions of approximately 70 to 80 percent. It was apparent that the amount of asphalt used and the pounds of chips spread were the correct amounts for that particular type of roadway surface.

The 120-150 penetration asphalt sections had too heavy an application of asphalt and will probably cause some bleeding in the advent of hot weather. There appeared to be good chip retention but only the larger chips were visible.

For this particular type of pavement the penetration asphalt quantities could have been reduced a considerable amount, probably down to approximately 0.17 to 0.18 gallons per square yard. If this had been done it is believed that an equally good seal coat probably would have been obtained with the penetration asphalt as with the RC-4N asphalt.

Attached are copies of the design information for the various seal coat sections, tabulations of temperatures and weather conditions during the time of seal coat application, and a graphic breakdown of the various sections. The following tentative conclusions have been made regarding the relative merits of the penetration, cutback, and neoprene modified asphalt. It is believed that the RC-5 asphalt is not adequate for sealing heavily traveled primary roads such as U.S. 30. It requires too long a curing period and, under the influence of heavy traffic, has an excessive loss of the large chips.

It also appears to bleed more readily than penetration or neoprene modified asphalt. The 120-150 penetration asphalt appears to be satisfactory for seal coating heavily traveled highways similar to U.S. 30 but care must be taken to prevent the application of too much asphalt. On this particular test section the optimum asphalt content appears to have been approximately 0.17 to 0.18 gallons per square yard.

Excellent results were obtained using the RC-4N asphalt except when used on a grade. At these points the chips had a tendency to roll, there was considerable blackening

of the roadway surface, and there is a possibility that some bleeding will take place during hot weather.

Of the three asphalts under consideration, the Penetration asphalt held up much better on the grades.

In the overall picture the entire seal coat test section had a good seal and, under the particular conditions that existed, the RC-4N asphalt gave the best results.

In all of the test sections the maintenance patches had bleeding throughout the seal coat. This is probably due to excessively rich roadmix used for patching. In the patches that were placed this spring there is such an excess of asphalt that it will probably cause considerable chip loss in the adjacent sections due to tracking.

In future condition surveys of the sections on which considerable patching has been done a close look must be given to determine whether or not any chip loss is due to the chips and asphalt used during the seal coat operations or whether it is due to the excessive amount of asphalt used in maintenance patching.

It is suggested that another survey be made this fall in order that the effects of hot weather and heavy summer traffic can be noted. Perhaps at that time definite conclusions can be made as to the relative merits of the three types of asphalt.

/s/ H. L. Day, P.E.
H. L. DAY
Materials Engineer

HLD/VEM/ekg

cc: ASHE - Oper.
Const. Engr.
District Engr.
Assistant Dist. Engr.
District Matls. Chief
District Mtce. Supt.

C
O
P
Y

Seal Coat Test Section
Boise East on US 20-26-30
Ada County

MAINTENANCE ENGINEER

November 1, 1960

MATERIALS ENGINEER

Condition Survey

On October 19, 1960 the Testing Engineer and Testing Chief from the Materials Section and District Materials Chief from District Three made a condition survey on captioned seal coat test section. A visual inspection was made of all the individual sections and the conclusions and comments are listed below by individual section.

Section A1, RC-4N asphalt E and WBL: WBL; good chip retention, approximately 75% remaining. There appeared to be an excess amount of asphalt which resulted in about 60% chip embedment. EBL: good chip retention, approximately 70% remaining. Excess amount of asphalt with about 70% chip embedment. The areas where there was alligator cracking the seal had failed with considerable chip loss.

Section A2, RC-4N asphalt E and WBL: Good chip retention, 70 to 75% remaining. Slightly too much asphalt with about 60% chip embedment. There was bleeding over all the rich patches. Overall, the seal had a good appearance.

Section B, RC-5 asphalt WBL, 120-150 Pen. EBL: WBL; poor chip retention approximately 35% remaining. Excess amount of asphalt with chip loss and extensive bleeding. Overall, the seal had a poor appearance. EBL: fair chip retention with approximately 50% remaining with excess amount of asphalt with bleeding on wheel tracks and over patched areas. The seal had a fair appearance.

Section C, 120-150 Pen. asphalt WBL, RC-5 asphalt EBL: WBL; fair chip retention with 50 to 55% remaining. There was excess amount of asphalt with bleeding and the chips in most cases were covered with asphalt. The seal had a poor appearance. EBL: poor chip retention with about 30 to 35% remaining. There was excess amount of asphalt with much bleeding and chip loss. The seal had poor appearance.

Section D, RC-4N asphalt WBL, 120-150 Pen. asphalt EBL: WBL; fair to good chip retention with 50 to 60% remaining. The roadway section through this area had numerous patches that had bled through the seal coat and as a result there was an excess amount of asphalt on the surface. Most of the chips were in place but were covered with asphalt. The seal had a fair appearance. EBL: poor chip retention, approximately 35% remaining. There was considerable asphalt on the surface and most of the chips retained were covered completely with asphalt.

There was a complete loss of chips in the shaded areas and on the large approaches. Overall, the roadway was in poor shape through this section which contributed to the poor appearance of the seal coat.

Section E, RC-5 asphalt WBL, RC-4N asphalt EBL: WBL; fair to poor chip retention with 30 to 40% remaining. There was also an excess amount of asphalt on the surface with some bleeding. EBL; fair to good chip retention with 50 to 60% remaining.

There appeared to be an excess amount of asphalt which caused bleeding over patched areas and along wheel tracks.

Section F, RC-4N asphalt WBL, 120-150 Pen. asphalt EBL: WBL; good chip retention with 70% remaining. There was very little bleeding and the amount of asphalt and the percent embedment appeared to be optimum. The seal had a good appearance. EBL: fair to poor chip retention with approximately 40% remaining. There was too much asphalt with bleeding in the wheel tracks and all but the largest chips were covered with asphalt. The seal had a poor appearance.

Section G, 120-150 Pen. asphalt WBL, RC-5 asphalt EBL: WBL; fair to poor chip retention with approximately 50% remaining. There was an excess amount of asphalt on surface with bleeding in the wheel tracks. The seal had a fair to poor appearance. EBL; there was poor chip retention with only about 25% remaining. There was extensive bleeding and the seal had a poor appearance. This road section was on grade which would contribute to the seal coat failure over the section.

Section H, RC-5 asphalt WBL, RC-4N asphalt EBL: fair chip retention with approximately 50% remaining. There appeared to be an excess of asphalt with some bleeding. EBL; good chip retention with 60 to 70% remaining. The appearance was good with the exception of some bleeding over rich patches.

Section I, RC-4N asphalt WBL, 120-150 Pen. asphalt EBL: WBL; good chip retention with approximately 75 to 80% remaining. It appeared that the correct amount of asphalt had been applied and the embedment of chips was close to the design figure of 30%. The seal had a good appearance. EBL; fair to good chip retention, approximately 50 to 60% remaining. There was an excess amount of asphalt applied which had caused bleeding in the wheel tracks and contributed to the fair to poor appearance. The roadway was in good shape through this area.

Sections J and K: Through this area there were alternating sections between the E and WBL using RC-4N asphalt and 120-150 Pen. asphalt. Overall, the RC-4N section had a very good seal with little or no bleeding and good chip retention. The 120-150 Pen. sections had too much asphalt applied which caused bleeding. There was very little chip loss but most of the chips remaining were almost completely covered with asphalt.

Attached are copies of the design information for the various seal coat sections, tabulation of temperatures and with conditions during the time of seal coat application and the graphic breakdown of the various sections.

Our conclusions are much the same as were included in the first condition survey on June 2, 1960 and covered by Materials Engineer's letter dated June 7, 1960.

The neoprene modified asphalt RC-4N gave the best results and the seal coat through the RC-4N sections still is in very good shape after 14 months of use. The RC-5 sections are in poor shape with much bleeding and considerable chip loss. The 120-150 Pen. asphalt sections had too much asphalt applied. The chips are still in place but they are almost completely covered with asphalt and during hot weather there has been considerable bleeding. The seal over the 120-150 Pen. sections can only be considered as being in fair to poor condition.

HLD/VEM/dlt

/s/ H. L. DAY
H. L. Day, P.E.
Materials Engineer

cc: ASHE - Oper.
Const. Engr.
Dist. Engr.
Dist. Matls. Chief
Assistant Dist. Engr. Dist. Mtce. Supt.

C O P Y

STATE OF IDAHO
DEPARTMENT OF HIGHWAYS
Boise, Idaho

June, 1960

SEAL COAT TEST SECTION

Boise East on U.S. 20-26-30 - Milepost 60 to 68

ASPHALT	APPLICATION TEMPERATURE
RC-5	250°-260°
RC-4 Modified with 1½% Neoprene	240°-250°
120 - 150	330°-340°

30% Embedment - Kearby - 0.23 G/SY

COVER COAT MATERIAL, CLASS 3

Size	% Pass
1/2 inch	100
3/8 inch	88
No. 4	22
No. 10	2

MINIMUM TEMPERATURE
over 24 hr. period

Sep 2 - 48°
Sep 3 - 57°
Sep 4 - 50°
Sep 5 - 57°
Sep 6 - 59°
Sep 7 - 53°
Sep 8 - 51°

WEATHER

September 2, 1959

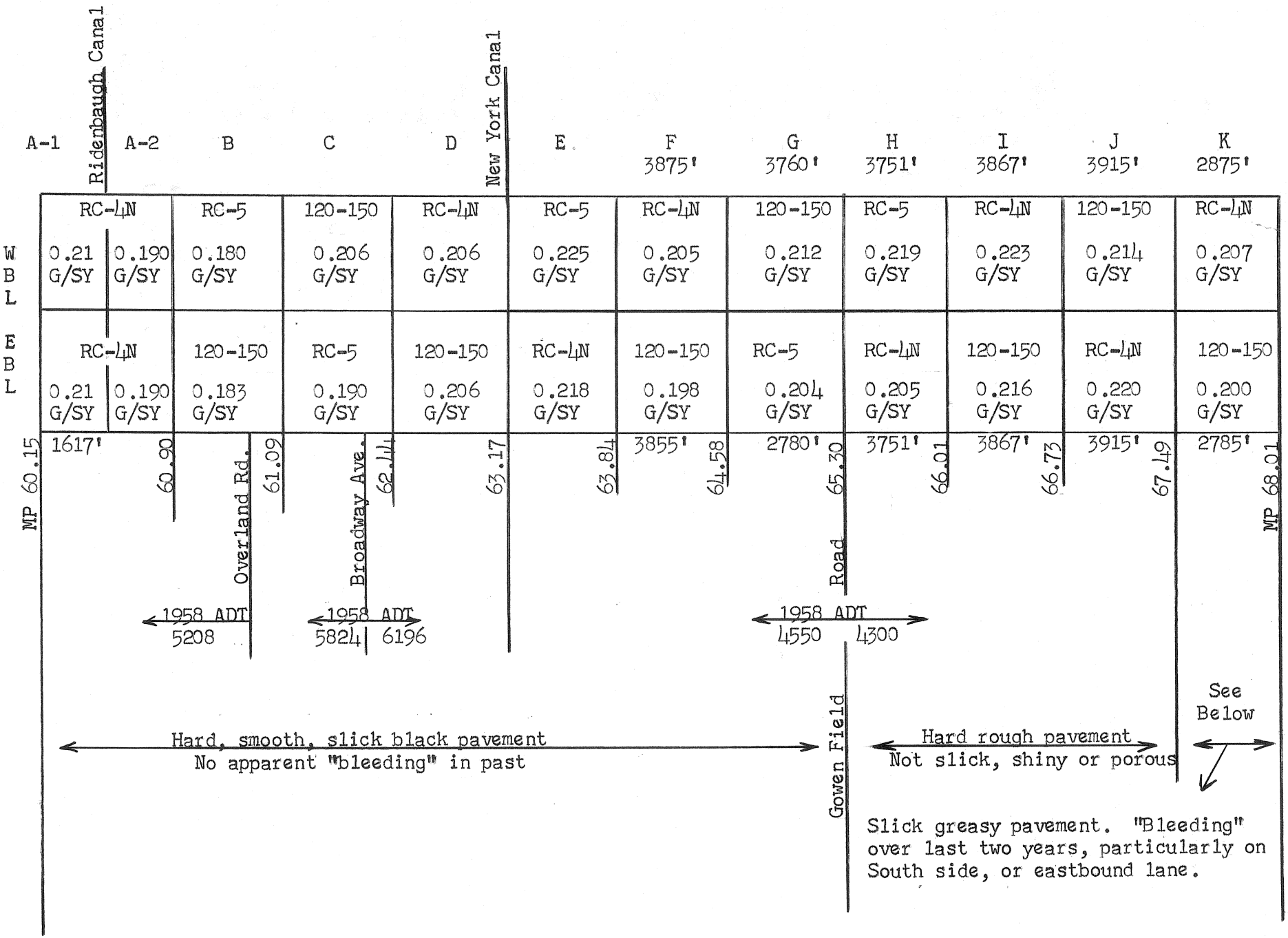
Air Temp. 67° to 82°
Wind, 9 mph
Sheltered Area. No Wind

September 3, 1959

Air Temp. 68° to 85°
Wind, 11 mph
Open Area. Very definitely windy.

SEAL COAT TEST SECTION

Boise East on U.S. 20-26-30 - Milepost 60 to 68



EXPERIMENTAL SEAL COAT CONDITION SURVEY US 30-20-26 BOISE EAST
CONSTRUCTED SEPTEMBER, 1959

Section	M.P. - M.P.	Lane	Asphalt	Application gal/sy	Condition Survey June 7, 1960	Condition Survey November 1, 1960	Condition Survey November 21, 1962
A-1	60.15-60.5±	EBL	RC-4N	0.21	Good - Uniform - 70% chip retention - No bleeding - Asphalt live & holding chips firmly.	Good Retention - 70% Appears excessive asphalt used - Embedment estimated 70% - Chip loss much greater on alligatored cracked areas.	50% Retention - Some bleeding or flushing.
A-1	60.15-60.5±	WBL	RC-4N	0.21	See A-1, EBL Above	Good retention - 75% Excess asphalt used 60% Embedment - Chip loss much greater on alligatored cracked areas.	50% Retention - Some bleeding or flushing.
A-2	60.5± - 60.90	EBL	RC-4N	0.19	Slightly better retention than A-1 Other remarks - see A-1.	Slightly better retention than A-1 Other remarks - see A-1.	50% Retention - Some bleeding or flushing.
A-2	60.5± - 60.90	WBL	RC-4N	0.19	See A-2, EBL Above	See A-2, EBL Above	See A-2, EBL Above
B	60.9 - 61.09	EBL	120-150	0.183	Retention - 75% - Chips Embedded 30-35% - Very good condition except one spot (shady) where chips lost immediately.	Retention Fair - 50% Fair appearance - Excess asphalt bleeding in wheel paths.	Serious flushing - Appears 10-20% Retention.

Section	M.P. - M.P	Lane	Asphalt	Application gal/sy	Condition Survey June 7, 1960	Condition Survey November 1, 1960	Condition Survey November 21, 1962
B	60.9 - 61.09	WBL	RC-5	0.180	Retention 55-65% - Most large chips lost Excess of Asphalt on Surface due to loss of chips.	Retention Poor - 35% - Excess asphalt - Extensive bleeding - Poor appearance.	Serious flushing - Appears to be 10-20% Retention.
C	61.09 - 62.44	EBL	RC-5	0.190	60-65% Retention - Some bleeding in wheel tracks.	30-35% Retention - bleeding badly - Poor appearance.	Serious flushing - chips embedded 10% retention.
C	61.09 - 62.44	WBL	120-150	0.206	70% Retention - 40-45% embedment - Sealed cracked areas well - Where traffic turns on pavement, lesser retention.	50-55% Retention - Excess asphalt - Poor appearance.	Serious flushing - chips embedded - less 10% Retention.
D	62.44 - 63.17	EBL	120-150	0.206	60% Retention - Some bleeding.	35% Retention - Chips remaining coated with asphalt.	10-15% Retention chips embedded.
D	62.44 - 63.17	WBL	RC-4N	0.206	70-75% Retention - No bleeding.	50-60% Retention - old patched areas bleeding- Fair appearance.	40% Retention - Flushing moderately to slight.
E	63.17 - 63.84	EBL	RC-4N	0.218	60-70% Retention - On the grade some rolling of chips - may bleed.	50-60% Retention - bleeding over patched areas.	30-40% Retention-Serious bleeding.
E	63.17 - 63.84	WBL	RC-5	0.225	60-70% Retention - Fair to good seal.	30-40% Retention bleeding excess asphalt.	10-20% Retention-Serious bleeding.

Section	M.P. - M.P.	Lane	Asphalt	Application gal/sy	Condition Survey June 7, 1960	Condition Survey November 1, 1960	Condition Survey November 21, 1962
F	63.84 - 64.58	EBL	120-150	0.198	75% Retention - Too much asphalt used. Embedment 50-60% - Only coarse chips visible.	40% Retention - Poor appearance - bleeding - too much asphalt.	20% Retention - Serious embedment & flushing.
F	63.84 - 64.58	WBL	RC-4N	0.205	80% Retention - No bleeding - very good appearance.	70% Retention - Very little bleeding - optimum amount asphalt & embedment.	90% Retention - Excellent appearance.
G	64.58 - 65.30	EBL	RC-5	0.204	Good Retention - no bleeding - on a grade but no loss evident.	25% Retention - bleeding extensively - Poor appearance on a grade.	10-15% Retention - flushing seriously.
G	64.58 - 65.30	WBL	120-150	0.212	Good Retention - too much asphalt used.	50% Retention - bleeding in wheel tracks - Poor to fair appearance.	Less 35% Retention - flushing moderately.
H	65.30 - 66.01	EBL	RC-4N	0.205	70-80% Retention - No bleeding - embedment 30-35% asphalt near optimum.	60-70% Retention - bleeding over some patched areas.	50-60% Retention - slight flushing on part.
H	65.30 - 66.01	WBL	RC-5	0.219	70-75% Retention - too much asphalt - Embedment 45-50% - may bleed.	50% Retention - excess asphalt - some bleeding.	Less 25% Retention - serious flushing.
I	66.01 - 66.73	EBL	120-150	0.216	Good Retention - too much asphalt - bleeding possible.	50-60% Retention - excess asphalt - bleed- in wheel tracks.	Less 10% Retention - serious flushing.

Section	M.P. - M.P.	Lane	Asphalt	Application gal/sy	Condition Survey June 7, 1960	Condition Survey November 1, 1960	Condition Survey November 21, 1962
I	66.01 - 66.73	WBL	RC-4N	0.223	70-80% Retention - good appearance.	75-80% Retention - 30% embedment - good appearance.	70-80% Retention - excellent appearance.
J	66.73 - 67.49	EBL	RC-4N	0.220	70-80% Retention - good appearance.	Good Retention - good appearance - little or no bleeding.	70%+ Retention - Excellent appearance - very slight flushing.
J	66.73 - 67.49	WBL	120-150	0.21X	Good Retention - too much asphalt - bleeding possible.	Good retention but bleeding in wheel paths.	Less 30% Retention - serious flushing - possibly some stripping.
K	67.49 - 68.01	EBL	120-150	0.200	Good retention - too much asphalt - bleeding possible.	Good Retention - but bleeding in wheel paths.	Less 10% Retention - bleeding very seriously 90% embedded.
K	67.49 - 68.01	WBL	RC-4N	0.207	70-80% Retention - good appearance.	Good Retention - Good appearance - little or no bleeding.	90%+ Retention excellent appearance - slight flushing.